FOUNDATION INVESTIGATION
PROPOSED PARKING STRUCTURE AND NEW PROGRESSIVE HEALTH CARE BUILDING
FOR
KUAKINI HOSPITAL
HONOLULU, OAHU, HAWAII

Dames & Moore Job No. 9807-001-11

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September 12, 1974

Group Architects Collaborative
926 Bethel Street
Honolulu, Hawaii 96813

Attention: Mr. Robert Kaminaga

Gentlemen:

Transmitted herewith are four copies of our report entitled "Foundation Investigation, Proposed Parking Structure and New Progressive Health Care Building for Kuakini Hospital, Honolulu, Oahu, Hawaii".

The scope of our work was presented in our proposal dated July 26, 1974, and this investigation has generally conformed to that proposal. For convenience, a brief summary of our recommendations is presnted on the first page of this report. A description of our field exploration precedures and the laboratory testing results are presented in the Appendix.

Samples of subsurface materials not destoryed during laboratory testing are being stored in our office for possible inspection and examination. According to our normal schedule, these samples will be discarded six months from this date, unless otherwise requested.

It has been a pleasure performing this investigation for you. Should you have any questions concerning the contents of this report, please contact us.

Yours very truly,

DAMES & MOORE

Mel Ban Lo

MBL:AKV:pdc

FOUNDATION INVESTIGATION
PROPOSED PARKING STRUCTURE AND
NEW PROGRESSIVE HEALTH CARE BUILDING
KUAKINI HOSPITAL
HONOLULU, OAHU, HAWAII

SUMMARY

Foundation support can be achieved by spread or wall footings either founded on a non-expansive silt layer which overlies basalt formation or on compentent basalt formation.

No unusual problems are anticipated during foundation excavation except boulders which could be excavated by conventional heavy equipments. Dewatering may be required.

INTRODUCTION

This report presents the results of our foundation investigation performed for the Proposed Parking Structure and New Progressive Health Care Building for Kuakini Hospital, to be located on the southern side of the hospital.

The general location of the site with respect to the surrounding area is depicted on Plate 1, Map of Area. The approximate locations of the proposed structures and the locations of Borings and Test Pits are shown on Plate 2, Plot Plan.

PROJECT CONSIDERATIONS

We understand that the proposed construction would include a parking structure and a progressive health care building. The parking structure would include eight parking levels, of which seven will be above grade and one below grade. The planned dimensions of this parking structure is approximately 273 feet by 129 feet. We understand that the finish floor elevation is set at 56 feet Mean Sea Level.

The new progressive health care building is understood to be eight stories high, including one basement. The configuration for this structure has not been finalized at this time. Finish floor elevation is believed to be 52 feet Mean Sea Level.

The grading plans have not been finalized as of the date of this report. Foundation loads are not known at present but they are believed to be moderate.

PURPOSE AND SCOPE OF WORK

In general, the purpose of the work performed in this study included the following:

1) To generally define the location and extent of the various types of materials underlying the site;

2) To evaluate the engineering properties of the subsurface materials encountered; and

3) To make foundation-related recommendations to aid in design and construction of the proposed facilities.

In order to accomplish the aforementioned purposes, the following scope of work was undertaken:

1) A field exploration program was conducted in which 11 borings were drilled, and 5 test pits were excavated. Relatively undisturbed and disturbed samples of the subsurface materials were recovered from the borings and test pits. A continuous log of each boring and test pit was maintained and detailed observations of site conditions pertinent to this exploration were made and recorded.

2) Various laboratory tests were performed on selected disturbed and undisturbed samples recovered during the field exploration to evaluate thier engineering properties.

3) Engineering analyses were conducted to develop recommendations for foundation design and construction of the proposed facilities.

4) All recommendations and related information were formalized and incorporated into this report.

A detailed description of the field exploration and laboratory testing is presented in the Appendix of this report. The Log of Borings and Test Pits and results of the field exploration and laboratory testing are also included in the Appendix.

SITE CONDITIONS

SURFACE CONDITIONS

The site of the proposed developement is located to the south of the existing Kuakini Hospital and is bordered by a stream on the south side. Approximately two-thirds of the site is currently covered by asphalt concrete and is being utilized as parking area. One- to two-story structures occupy part of the north portion of the site. Several large

trees and other vegetation exist at scattered location of the property. The entire area for the proposed development slopes gently from north to south with surface elevations ranging from about 70 feet on the north and 50 feet at the upper edge of the stream bank to the south.

SUBSURFACE CONDITIONS

The subsurface conditions at the site were explored by drilling 11 borings ranging in depth from 16.5 feet to 29.0 feet, and excavating 5 test pits ranging in depth from 5.5 feet to 10.5 feet. Locations of borings and test pits are depicted on the Plot Plan, Plate 2. Based on the information obtained from borings and test pits, the site is mantled with a layer of medium stiff clayey silt containing some gravel and boulders. This layer ranges in thickness from roughly 2 to 12 feet.

Underlying the surface material, a stiff black organic silt, containing numerous boulders was encountered in Boring Nos. 10 and 11, Test Pit Nos. 2 and 5. Materials described above contains expansive adobe-type soils. Below these layers is a layer of decomposed basaltic material as much as 13 feet in thickness containing stiff red-brown and gray clayey silt, sands and gravel along with a few boulders. This grades to a gray slightly vesicular basalt formation at elevations ranging from 43 feet to 50 feet, Mean Sea Level.

Groundwater was measured during our exploration. Depth of groundwater ranged from 5.0 feet in Boring No. 1 to 10.4 feet in Test Pit No. 5.

It is believed that the groundwater level may fluctuate significantly, depending upon seasonal rainfall variations.

For clarification purposes, our general interpretation of subsurface conditions encountered at the site is presented on Plates 3 and 4, Generalized Subsurface Cross-Sections. The material encountered in our exploration are described according to the Unified Soil Classification System.

DISCUSSIONS AND RECOMMENDATIONS

FOUNDATION SUPPORT

Spread or continuous footings could be used for the foundation support of the proposed structures. We recommend the following allowable bearing pressures for the foundation design.

Footings placed on stiff clayey silt (decomposed basalt) below adobe - 4,000 pounds per square foot;

Footings placed on competent basalt formation - 10,000 pounds per square foot.

The recommended bearing pressure may be increased by one-third for infrequently applied live loads, such as wind or seismic. However, the minimum footing width should be limited to 18 inches.

If the footings are placed in the stiff clayey silt layer, we recommend that the footings be based at least three feet below the lowest adjacent finished grade. We also recommend that tie-beams be provided to connect footings at the southern boundary near the stream.

Total settlement on the order of 1.2 inches should be anticipated in the structural design of footings placed on stiff clayey silt (decomposed basalt), below the adobe layer. Differential settlement between adjacent columns or walls of one-half the amount of total settlement should also be anticipated. No settlement is anticipated if footings are founded on competent basalt.

We recommend that all the footings be placed either on clayey silt or on basalt formation to eliminate large differential settlement.

We wish to emphasize that a spread footing foundation system would require extensive excavation. It is anticipated that excavation might extend several feet below the lowest groundwater table, depending upon which month

the constuction starts. Information available on Nuuanu Stream indicates that highest water level reached the ±50 feet elevation during the peak rainy seasons in the past. Excavations during heavy flow in Nuuanu Stream would necessitate extensive dewatering. Deep excavations may also require shoring.

SITE PREPARATION AND EARTHWORK

After the demolition of existing buildings and removal of trees and other vegetation, the entire structural area and areas to receive fill should be carefully stripped of all organic matter, and expansive adobe materials. Based on our investigation, the bottom of adobe materials would range approximately from elevations 55 to 50 feet. The materials should be removed to a minimum lateral distance of five feet outside the building and foundation area.

Stripped materials may be stockpiled and used for landscaping purposes. Excavated on-site materals, provided that they are free from deleterious materials, adobe, and large boulders, may be stockpiled during excavation, and subsequently used as fill and backfill, if required. Fill and backfill should be placed in horizontal lifts such that a compacted thickness of approximately six inches would be obtained. Each lift should be compacted to a minimum of

95 percent and 90 percent of its maximum dry density as determined by the modified AASHO test designation T-180, for fills placed within and outside the structure, respectively.

Excavation operations for construction of foundations may be accomplished utilizing heavy earth-moving equipments. Surface drainage should be diverted away from the construction site when excavations are open. Care should be taken during excavation so that the material at the supporting elevation of the foundation are not over-excavated or disturbed. All loose materials should be completely removed from the foundation excavations prior to placement of concrete or reinforcing steel.

Dewatering may be required during excavation operations.

SLABS-ON-GRADE AND ASPHALTIC PAVEMENT

We recommend that the on-site expansive adobe material be removed at least two feet below the on-grade slabs, sidewalks and pavement areas. The removed adobe material should be replaced with non-expansive, granular material compacted to 95 percent of its maximum dry density.

We also recommend that a vapor barrier be used under the on-grade slab. We recommend a pavement section consisting of two inches of asphaltic concrete and six-inch of base course compacted to 95 percent be used for the parking areas and driveways.

LATERAL EARTH PRESSURE

Basement walls should be designed to withstand earth pressure exerted by subsoils. An uniform lateral earth pressure, in pounds per square foot, equals to 25 times the height of wall (in feet, below ground) can be used for the restrained basement wall design. A triangular distribution resulting from an equivalent fluid weight of 50 pounds per cubic foot may be used for design of free standing retaining walls. An open grade gravel layer should be placed behind all basement and retaining walls with a buried perforated drain pipe or weep holes to remove all water from behind the walls.

FIELD INSPECTION

Recommendations presented in this report are based upon the soils encountered in the borings drilled and test pits excavated during our field investigation. Should

different soil conditions be encountered furing construction, a foundation engineer should be consulted and appropriate modifications implemented, if necessary. We recommend that foundation excavation be inspected and approved by a qualified soils engineer. Additionally, we recommend that fill and backfill placement also be inspected and approved by a qualified soils engineer.

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The following Plates and Appendix are attached and complete this report.

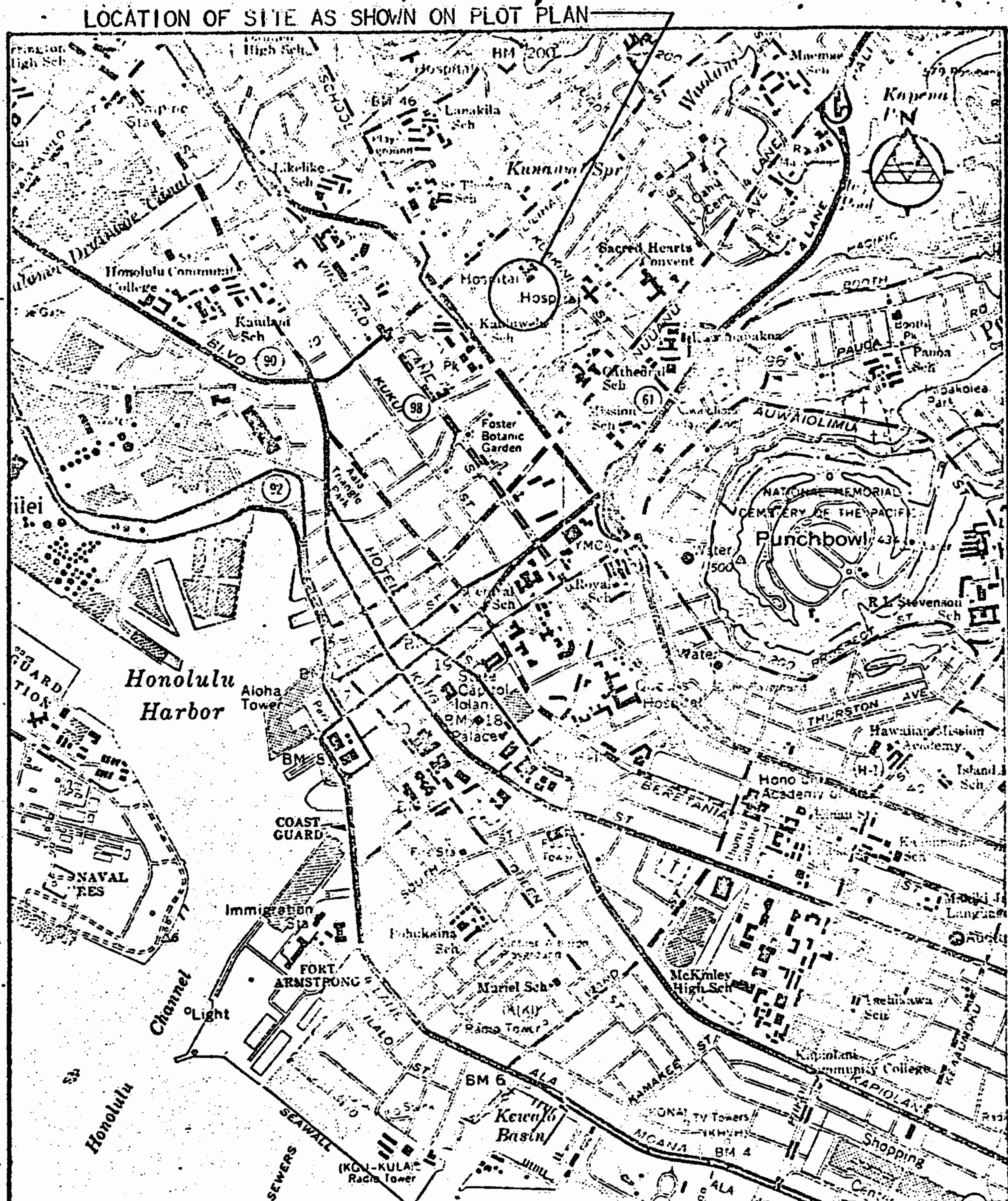
Plate 1	Map of Area
Plate 2	Plot Plan
Plate 3	Generalized Subsurface Cross-Section A-A'
Plate 4	Generalized Subsurface Cross-Section B-B'
Appendix	Field Exploration and Laboratory Testing

Respectfully submitted,

DAMES & MOORE

Mei-Ban Lo

THIS WORK WAS PREPARED BY
ME OR UNDER MY SUPERVISION.



MAP OF AREA

SCALE 1:24 000

1 ½ 0 1 MILE

1000 0 1000 2000 3000 4000 5000 6000 7000 FEET

1 .5 0 1 KILOMETER

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PLATE 1

REVISIONS BY DATE

CHECKED BY DATE

PROPOSED
8 - STORY
BUILDING

PROPOSED MULTI - DECK
PARKING STRUCTURE

KUAKINI STREET

Top of Bank

TP-1
TP-2
TP-3
TP-4
TP-5

REFERENCE:

TOPOGRAPHIC & CONTOUR PLOT
PLAN OF KUAKINI PARKING
STRUCTURE
NOT DATED

LEGEND:

DAMES & MOORE BORINGS
DAMES & MOORE TEST PITS

PLOT PLAN

FEET
10 5 0 10 20 30 40 50

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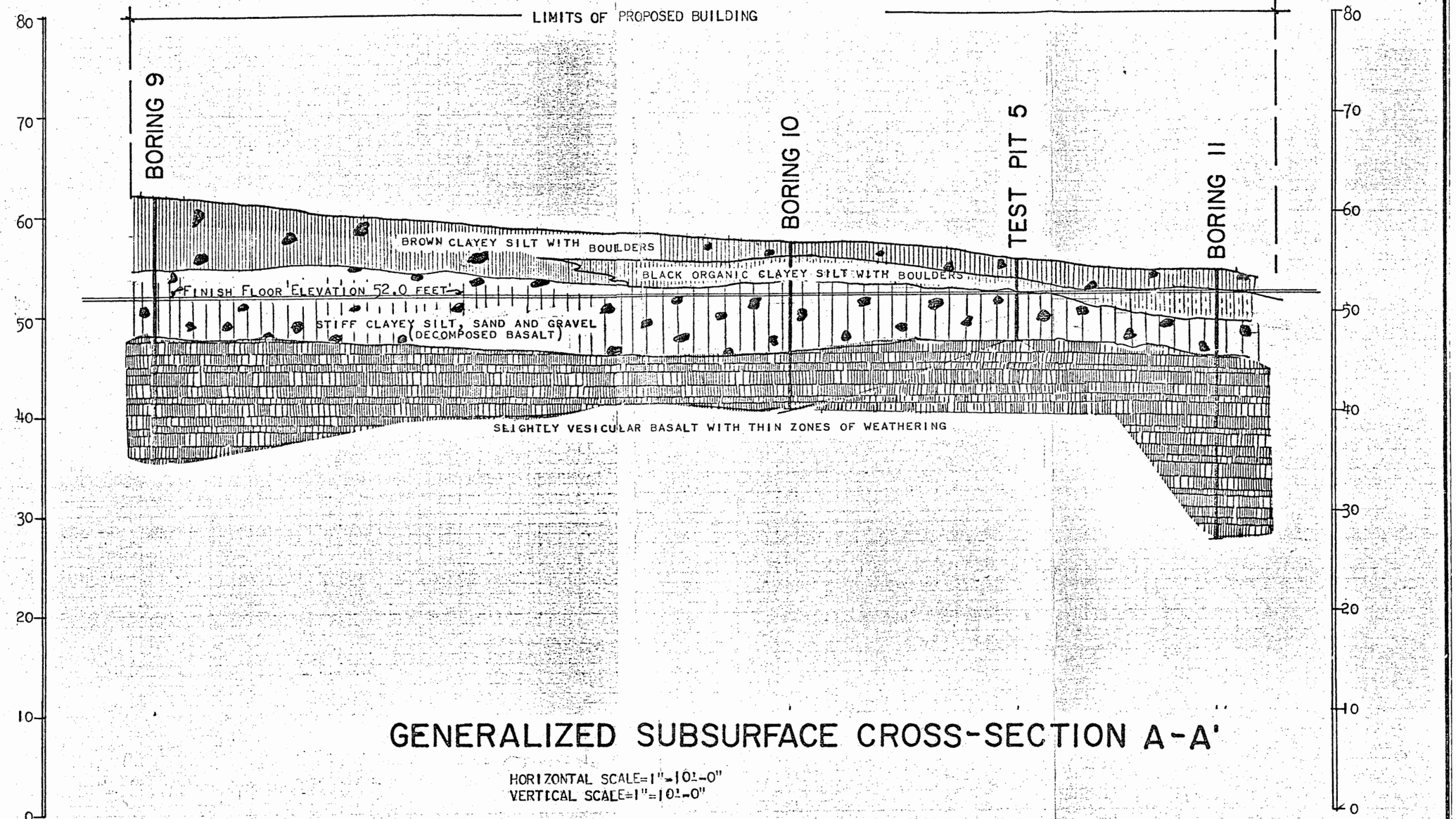
PLATE 2

REVISIONS
NO. BY DATE
NO. BY DATE
PLATE NO. OF

FILE 6297-001
WY. CHECKED BY DATE 11-21-67

46-11 (3M)



GENERALIZED SUBSURFACE CROSS-SECTION A-A'

HORIZONTAL SCALE=1"=10'-0"
VERTICAL SCALE=1"=10'-0"

NOTE: The conditions illustrated between borings are based on geological interpretations.
While these are believed to be generally correct, the conditions may vary locally from those indicated.

DRAWN BY DLH DATE 9/22/71
CHECKED BY JEM DATE 9/24/71

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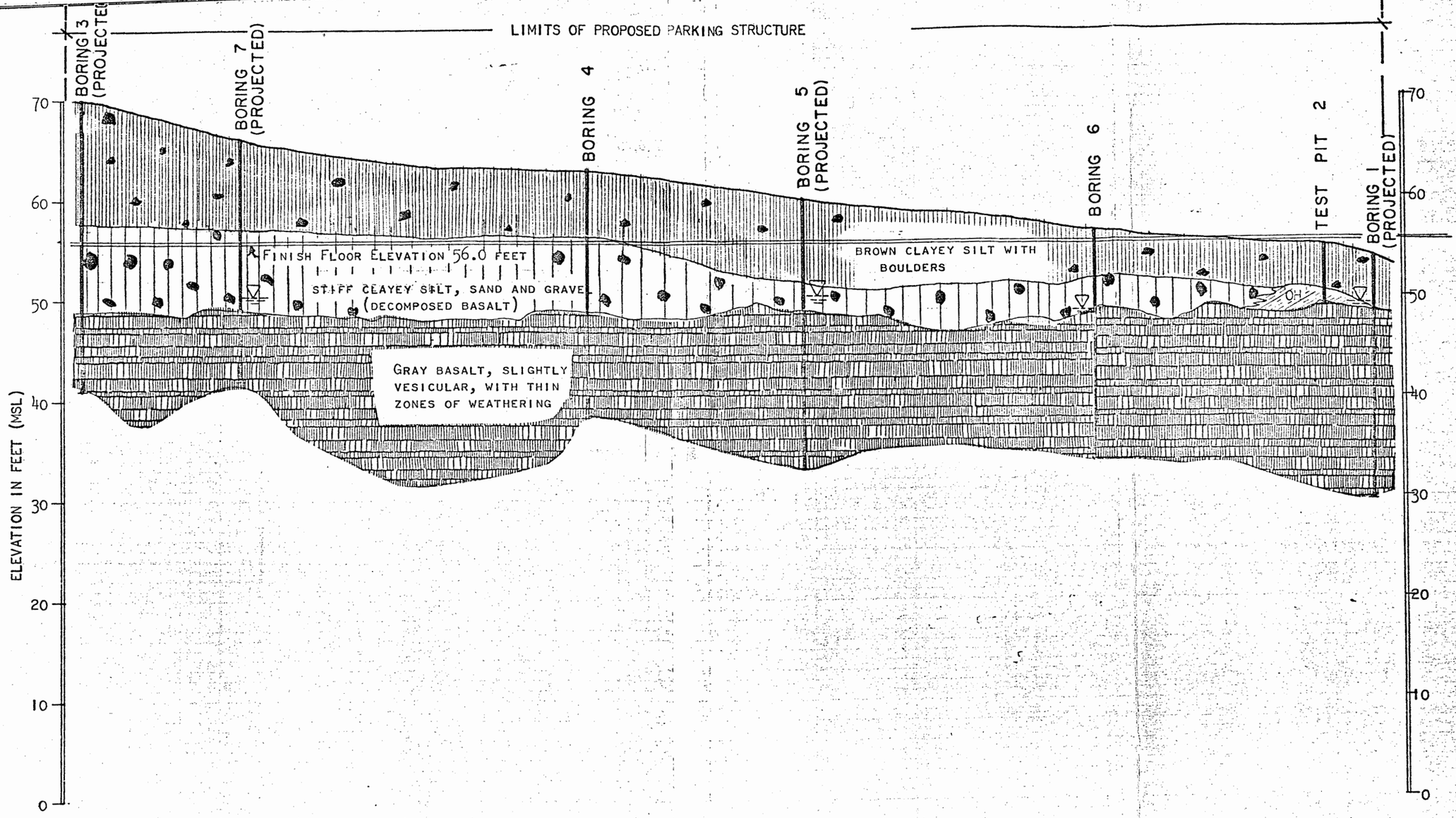
PLATE 3



GENERALIZED SUBSURFACE CROSS-SECTION B-B'

HORIZONTAL SCALE: 1"=10'-0"
VERTICAL SCALE: 1"=10'-0"

NOTE: The conditions illustrated between borings are based on geological interpretations.
While these are believed to be generally correct, the conditions may vary locally from those indicated.

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PLATE 4

APPENDIX

FIELD EXPLORATION AND LABORATORY TESTING

FIELD EXPLORATION

The subsurface conditions at the site were explored by drilling 11 borings ranging in depth from 16.5 feet to 29.0 feet, and excavating 5 test pits at the locations shown on the Plot Plan, Plate 2, in the body of this report. The borings were drilled by Continental Drilling Company, our subcontractor. Broings were drilled with a truckmounted Mobile B-40L drill rig. All borings were drilled utilizing both auger and rotary-wash equipment. The test pits were excavated by a backhoe. Relatively undisturbed and disturbed samples of the subsoils encountered were recovered using a Dames & Moore Type U sampler depicted on Exhibit A-1.

A Dames & Moore engineer was presented at the site during the field exploration to direct technically the drilling operations, indentify samples of the subsurface materials recovered from the borings and make pertinent field observations regarding site conditions. Subsurface materials recovered from the borings were classified according

to the Unified Soil Classification System. An explanation of the Unified Soil Classification System is presented in Plate A-2. Descriptions and classifications of subsurface materials are presented on the Log of Borings Plates A-1A through A-1K, and Log of Test Pits, Plates A-1L and A-1M. Records of penetration resistance obtained during sampleing are depicted on the Log of Borings.

LABORATORY TESTING

Selected samples of the subsurface materials were subjected to various laboratory test in order to evaluate their engineering properties. A description of the tests and the test results are presented below.

Unconfined Compression and Triaxial Compression Test - Several samples were subjected to unconfined compression and unconsolidated-undrained triaxial compression tests in order to evaluate their strength characteristics. The tests were conducted according to the test procedures presented on Exhibit A-2. The results of the tests are summarized on the following page.

BORING No.	DEPTH (ft)	FIELD MOISTURE (%)	FIELD DRY DENSITY (lbs/cu.ft)	CONFINING PRESSURE (lbs/sq.ft)	PEAK DEVIATOR STRESS (lbs/sq.ft)
8	16.0	29.8	--	1,500	3,795
8	6.5	27.0	90.9	500	3,977
*7	22.0	--	159.8	--	1,818,468
*10	11.6	--	160.6	--	1,742,699
*4	21.0	--	156.9	--	473,559

*CORE SAMPLE

Consolidation Tests - Consolidation tests were performed on soil samples to evaluate their compressibility characteristics. Soil samples were subjected to saturation and a loading cycle. A description of the test procedure is presented on Exhibit A-3. The test results are presented on Plate A-3.

Expansion Tests - In order to evaluate the expansive characteristics of the subsurface materials, expansion tests were performed on selected samples in conjection with the consolidation test. A load of 100 pounds was used as surcharge. The results are presented on the following page.

BORING NO.	DEPTH (ft.)	NATURAL (%) Moisture Content	PERCENT EXPANSION
4	7.6	45.0	0.71
5	5.5	50.1	5.06
9	2.7	61.3	6.36

Moisture Content and Dry Density Determinations - Numerous samples were subjected to moisture content and dry density determinations. The results of the moisture and density determinations are tabulated on the Log of Borings at the approximate depth.

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The following Exhibits and Plates are attached and complete this Appendix.

Exhibit A-1 - Soil Sampler Type U

Exhibit A-2 - Methods of Performing Unconfined Compression and Triaxial Compression Tests

Exhibit A-3 - Method of Performing Consolidation Tests

Plate A-1A - Log of Borings, Boring 1

Plate A-1B - Log of Borings, Boring 2

Plate A-1C - Log of Borings, Boring 3

Plate A-1D - Log of Borings, Boring 4

Plate A-1E - Log of Borings, Boring 5

Plate A-1F - Log of Borings, Boring 6

Plate A-1G - Log of Borings, Boring 7

Plate A-1H - Log of Borings, Boring 8

Plate A-1I - Log of Borings, Boring 9

Plate A-1J - Log of Borings, Boring 10

Plate A-1K - Log of Borings, Boring 11

Plate A-1L - Log of Test Pits, Test Pits 1, 2, 3, 4

Plate A-1M - Log of Test Pits, Test Pit 5

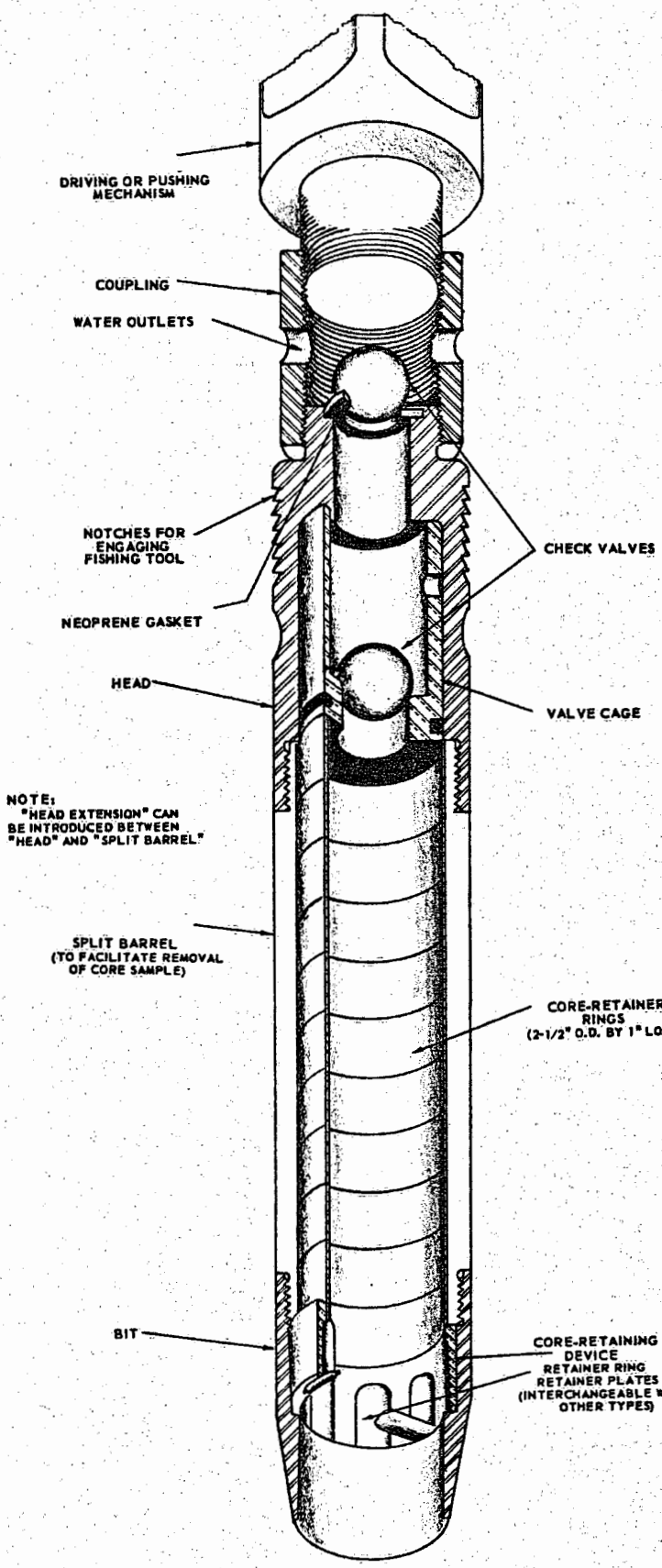
Plate A-2 - Unified Soil Classification System

Plate A-3 - Consolidation Test Data

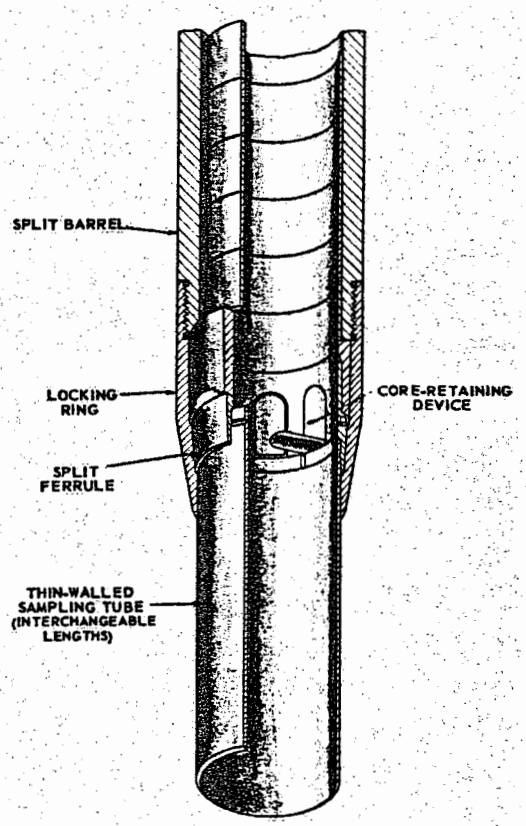
- oOo -

SOIL SAMPLER TYPE U

FOR SOILS DIFFICULT TO RETAIN IN SAMPLER



ALTERNATE ATTACHMENTS



417.9 (5-68)

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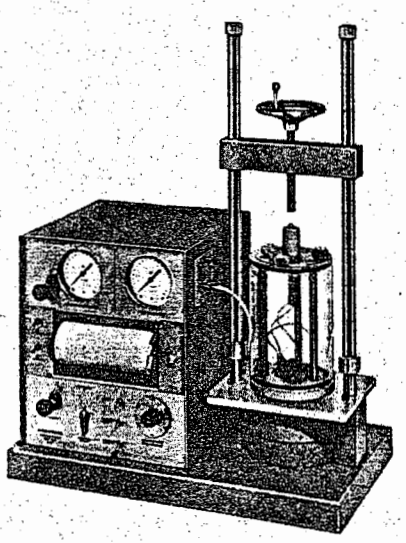
METHODS OF PERFORMING UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS

THE SHEARING STRENGTHS OF SOILS ARE DETERMINED FROM THE RESULTS OF UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS. IN TRIAXIAL COMPRESSION TESTS THE TEST METHOD AND THE MAGNITUDE OF THE CONFINING PRESSURE ARE CHOSEN TO SIMULATE ANTICIPATED FIELD CONDITIONS.

UNCONFINED COMPRESSION AND TRIAXIAL COMPRESSION TESTS ARE PERFORMED ON UNDISTURBED OR REMOLDED SAMPLES OF SOIL APPROXIMATELY SIX INCHES IN LENGTH AND TWO AND ONE-HALF INCHES IN DIAMETER. THE TESTS ARE RUN EITHER STRAIN-CONTROLLED OR STRESS-CONTROLLED. IN A STRAIN-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO A CONSTANT RATE OF DEFLECTION AND THE RESULTING STRESSES ARE RECORDED. IN A STRESS-CONTROLLED TEST THE SAMPLE IS SUBJECTED TO EQUAL INCREMENTS OF LOAD WITH EACH INCREMENT BEING MAINTAINED UNTIL AN EQUILIBRIUM CONDITION WITH RESPECT TO STRAIN IS ACHIEVED.



TRIAXIAL COMPRESSION TEST UNIT

YIELD, PEAK, OR ULTIMATE STRESSES ARE DETERMINED FROM THE STRESS-STRAIN PLOT FOR EACH SAMPLE AND THE PRINCIPAL STRESSES ARE EVALUATED. THE PRINCIPAL STRESSES ARE PLOTTED ON A MOHR'S CIRCLE DIAGRAM TO DETERMINE THE SHEARING STRENGTH OF THE SOIL TYPE BEING TESTED.

UNCONFINED COMPRESSION TESTS CAN BE PERFORMED ONLY ON SAMPLES WITH SUFFICIENT COHESION SO THAT THE SOIL WILL STAND AS AN UNSUPPORTED CYLINDER. THESE TESTS MAY BE RUN AT NATURAL MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SOILS.

IN A TRIAXIAL COMPRESSION TEST THE SAMPLE IS ENCASED IN A RUBBER MEMBRANE, PLACED IN A TEST CHAMBER, AND SUBJECTED TO A CONFINING PRESSURE THROUGHOUT THE DURATION OF THE TEST. NORMALLY, THIS CONFINING PRESSURE IS MAINTAINED AT A CONSTANT LEVEL, ALTHOUGH FOR SPECIAL TESTS IT MAY BE VARIED IN RELATION TO THE MEASURED STRESSES. TRIAXIAL COMPRESSION TESTS MAY BE RUN ON SOILS AT FIELD MOISTURE CONTENT OR ON ARTIFICIALLY SATURATED SAMPLES. THE TESTS ARE PERFORMED IN ONE OF THE FOLLOWING WAYS:

UNCONSOLIDATED-UNDRAINED: THE CONFINING PRESSURE IS IMPOSED ON THE SAMPLE AT THE START OF THE TEST. NO DRAINAGE IS PERMITTED AND THE STRESSES WHICH ARE MEASURED REPRESENT THE SUM OF THE INTERGRANULAR STRESSES AND PORE WATER PRESSURES.

CONSOLIDATED-UNDRAINED: THE SAMPLE IS ALLOWED TO CONSOLIDATE FULLY UNDER THE APPLIED CONFINING PRESSURE PRIOR TO THE START OF THE TEST. THE VOLUME CHANGE IS DETERMINED BY MEASURING THE WATER AND/OR AIR EXPELLED DURING CONSOLIDATION. NO DRAINAGE IS PERMITTED DURING THE TEST AND THE STRESSES WHICH ARE MEASURED ARE THE SAME AS FOR THE UNCONSOLIDATED-UNDRAINED TEST.

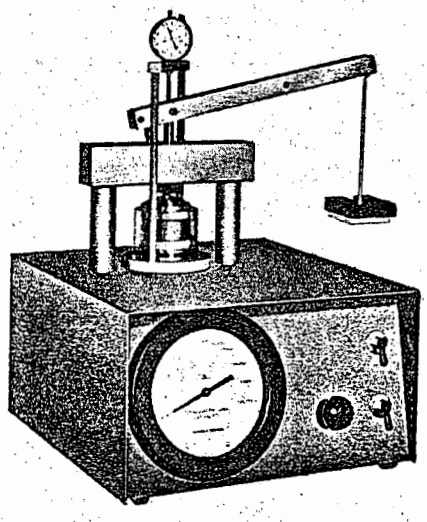
DRAINED: THE INTERGRANULAR STRESSES IN A SAMPLE MAY BE MEASURED BY PERFORMING A DRAINED, OR SLOW, TEST. IN THIS TEST THE SAMPLE IS FULLY SATURATED AND CONSOLIDATED PRIOR TO THE START OF THE TEST. DURING THE TEST, DRAINAGE IS PERMITTED AND THE TEST IS PERFORMED AT A SLOW ENOUGH RATE TO PREVENT THE BUILDUP OF PORE WATER PRESSURES. THE RESULTING STRESSES WHICH ARE MEASURED REPRESENT ONLY THE INTERGRANULAR STRESSES. THESE TESTS ARE USUALLY PERFORMED ON SAMPLES OF GENERALLY NON-COHESIVE SOILS, ALTHOUGH THE TEST PROCEDURE IS APPLICABLE TO COHESIVE SOILS IF A SUFFICIENTLY SLOW TEST RATE IS USED.

AN ALTERNATE MEANS OF OBTAINING THE DATA RESULTING FROM THE DRAINED TEST IS TO PERFORM AN UNDRAINED TEST IN WHICH SPECIAL EQUIPMENT IS USED TO MEASURE THE PORE WATER PRESSURES. THE DIFFERENCES BETWEEN THE TOTAL STRESSES AND THE PORE WATER PRESSURES MEASURED ARE THE INTERGRANULAR STRESSES.

METHOD OF PERFORMING CONSOLIDATION TESTS

CONSOLIDATION TESTS ARE PERFORMED TO EVALUATE THE VOLUME CHANGES OF SOILS SUBJECTED TO INCREASED LOADS. TIME-CONSOLIDATION AND PRESSURE-CONSOLIDATION CURVES MAY BE PLOTTED FROM THE DATA OBTAINED IN THE TESTS. ENGINEERING ANALYSES BASED ON THESE CURVES PERMIT ESTIMATES TO BE MADE OF THE PROBABLE MAGNITUDE AND RATE OF SETTLEMENT OF THE TESTED SOILS UNDER APPLIED LOADS.

EACH SAMPLE IS TESTED WITHIN BRASS RINGS TWO AND ONE-HALF INCHES IN DIAMETER AND ONE INCH IN LENGTH. UNDISTURBED SAMPLES OF IN-PLACE SOILS ARE TESTED IN RINGS TAKEN FROM THE SAMPLING DEVICE IN WHICH THE SAMPLES WERE OBTAINED. LOOSE SAMPLES OF SOILS TO BE USED IN CONSTRUCTING EARTH FILLS ARE COMPACTED IN RINGS TO PREDETERMINED CONDITIONS AND TESTED.



DEAD LOAD-PNEUMATIC CONSOLIDOMETER

IN TESTING, THE SAMPLE IS RIGIDLY CONFINED LATERALLY BY THE BRASS RING. AXIAL LOADS ARE TRANSMITTED TO THE ENDS OF THE SAMPLE BY POROUS DISKS. THE DISKS ALLOW DRAINAGE OF THE LOADED SAMPLE. THE AXIAL COMPRESSION OR EXPANSION OF THE SAMPLE IS MEASURED BY A MICROMETER DIAL INDICATOR AT APPROPRIATE TIME INTERVALS AFTER EACH LOAD INCREMENT IS APPLIED. EACH LOAD IS ORDINARILY TWICE THE PRECEDING LOAD. THE INCREMENTS ARE SELECTED TO OBTAIN CONSOLIDATION DATA REPRESENTING THE FIELD LOADING CONDITIONS FOR WHICH THE TEST IS BEING PERFORMED. EACH LOAD INCREMENT IS ALLOWED TO ACT OVER AN INTERVAL OF TIME DEPENDENT ON THE TYPE AND EXTENT OF THE SOIL IN THE FIELD.

BORING 1

SURFACE ELEVATION 54.0 ± FEET

MOISTURE CONTENT IN %	DRY DENSITY IN PCF	BLOWS/FT. ON SAMPLER	CORE AND % RECOVERY	SAMPLES AND/OR CORES	DEPTH IN FEET	GRAPH SYMBOL	LETTER SYMBOL	DESCRIPTION
		21					MH	BROWN CLAYEY SILT WITH SOME SAND AND GRAVEL AND ROOTS (SOFT)(FILL)
		33/6"					MH	WATER LEVEL AT 0945 HOURS ON 8-21-74 BROWN CLAYEY SILT WITH SOME GRAVEL (MEDIUM STIFF)(DECOMPOSED BASALT)
			NX 90%		10			GRADES WITH SOME BOULDERS GRAY BASALT, SLIGHTLY VESICULAR, VERY HARD
			NX 100%					BECOMES WEATHERED BASALT WITH SEAMS OF CLAYEY SILT
			NX 20%		20			

BORING COMPLETED AT 24.5 FEET ON 8-13-74

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- □ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN

DRIVING ENERGY - -LB WEIGHT DROPPING INCHES

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PLATE A-1A

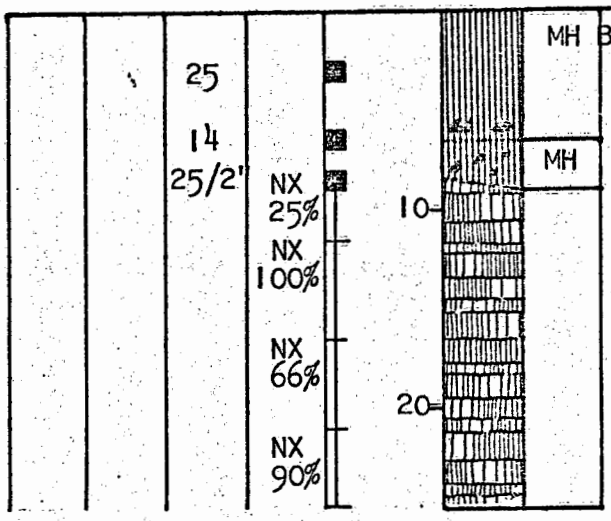
MISC. BY DATE

FILE 8607-061

CHECKED BY MH DATE 9-13-74

BORING 2

SURFACE ELEVATION 54.0±
MSL DATUM



BROWN CLAYEY SILT WITH SOME SAND (MEDIUM STIFF, FILL)
GRADES WITH SOME GRAVEL AND ROOTS
BECOMES WITH SOME BOULDERS

BROWN CLAYEY SILT WITH SOME GRAVELS (STIFF) (DECOMPOSED BASALT)

GREY BASALT, SLIGHTLY VESICULAR (VERY HARD)

BORING COMPLETED AT 25.0 FEET ON 8-13-74
NO WATER MEASURED
(HOLE CAVED IN BEFORE WATER LEVEL STABILIZED)

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- □ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN

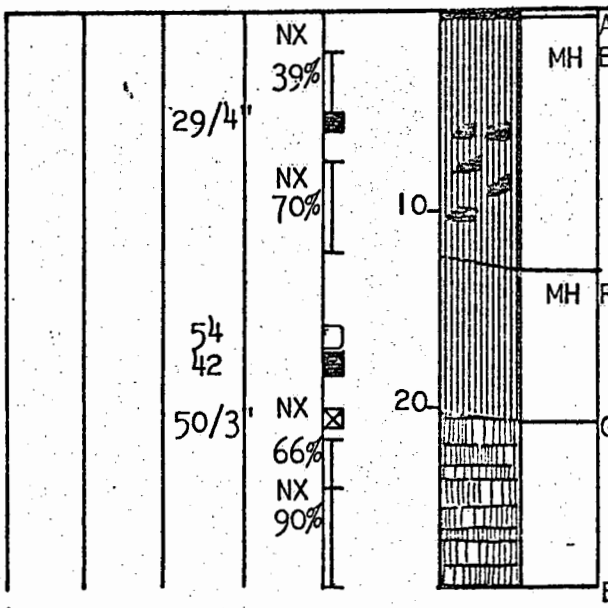
DRIVING ENERGY - 300 -LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE
PLATE A-1B

FILE 9207-001
CHECKED BY
DATE
BY

BORING 3

Surface Elevation 70.0±
MSL Datum



Description

Asphaltic pavement 1" thick

MH Brown clayey silt (medium stiff)

grades with boulders

MH Reddish brown clayey silt (stiff)
(decomposed basalt)

Grey basalt with thin seams of weathering
(very hard)

Boring completed at 29.0 feet on 8-15-74
No water measured
(hole caved in before water level stabilized)

LOG OF BORINGS

NOTES:

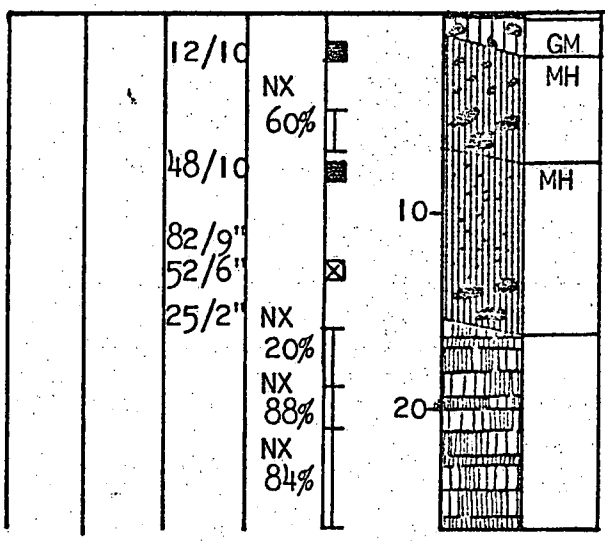
- ▩ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- ☐ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN
- Driving Energy - 300 -lb weight dropping 30 inches

DAMES & MOORE
PLATE A-1C

FILE 7-001 DATE
BY
VIS
CHECKED BY

BORING 4

Surface Elevation 65.0 ± feet
MSL Datum



Description
Asphaltic pavement 1" thick
Brown silty gravel, loose
Gray clayey silt with occasional gravel (soft, grades with boulders
Light grey mottled brown clayey silt and sand (decomposed basalt) (stiff)
grades with boulders
Grey basalt, vesicular (hard)

Boring completed at 26.0 feet on 8-16-74
No water measured
(Hole caved in before water levle stabilized)

LOG OF BORINGS

NOTES:

- ▩ -depth at which undisturbed sample was taken
- ⊠ -depth at which disturbed sample was taken
- ☐ -depth at which sample was lost during extraction
- I -depth and length of core run

Driving Energy - 300 -lb weight dropping 30 inches

DAMES & MOORE
PLATE A-1D

REVISIONS BY DATE

FILE 6227-001

CHECKED BY MKV DATE 9-11-74

BORING 5

SURFACE ELEVATION 60.0± MSL DATUM

MOISTURE CONTENT IN %	DRY DENSITY IN PCF	BLOWS/FT. ON SAMPLER	CORE AND % RECOVERY	SAMPLES AND/OR CORES	DEPTH IN FEET	GRAPH SYMBOL	LETTER SYMBOL	DESCRIPTION
48.2	70.3	7					MH	BROWN CLAYEY SILT, MEDIUM STIFF (FILL)
50.1	72.0	11						GRADES WITH BOULDERS
								WATER LEVEL AT 1230 HOURS ON 8-16-74
63.9	83.9	56/10			10		MH	BROWN MOTTLED GREY CLAYEY SILT AND SAND (DECOMPOSED BASALT) (MEDIUM STIFF)
			NX 80%					GREY VESICULAR BASALT (HARD)
			NX 84%					BECOMES SLIGHTLY WEATHERED
			NX 100%		20			
								BORING COMPLETED AT 27.0 FEET ON 8-19-74

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- ☐ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN
- DRIVING ENERGY - 300-LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE
PLATE A-1E

REVISIONS BY DATE

FILE

CHECKED BY DATE

(REV. 6-61)

BORING 6

SURFACE ELEVATION 57.0± MSL DATUM

MOISTURE CONTENT IN %	DRY DENSITY IN PCF	BLOWS/FT. ON SAMPLER	CORE AND % RECOVERY	SAMPLES AND/OR CORES	DEPTH IN FEET	GRAPH SYMBOL	LETTER SYMBOL	DESCRIPTION
46.9	71.9	12					MH	BROWN CLAYEY SILT AND SOME GRAVEL MEDIUM STIFF (FILL)
		15					MH	BROWN MOTTLED CLAYEY SILT (STIFF) (DECOMPOSED BASALT) WATER LEVEL AT 0940 HOURS ON 8-21-74
			NX 54%		10			GREY VESICULAR BASALT, HARD
			NX 100%					
			NX 100%		20			

BORING COMPLETED AT 23.0 FEET ON 8-19-74

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- ☐ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN
- DRIVING ENERGY - 300 -LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE

PLATE A-1F

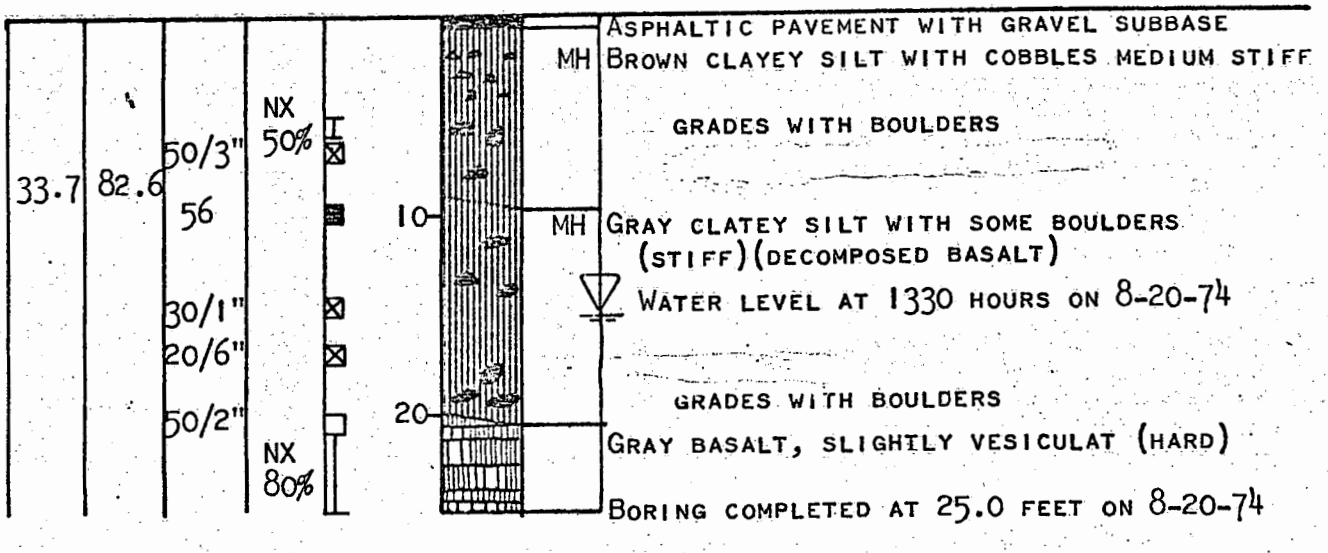
REVISIONS BY DATE

CHECKED BY FILE

(REV. 8-61)

BORING 7

Surface Elevation 66 ± feet
MSL Datum



LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- □ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN

Driving Energy - 300-LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE
PLATE A-IG

FILE 2007-001
DATE
BY
REVISIONS
CHECKED BY

BORING 8

Surface Elevation 60 ± feet
MSL Datum

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler	Core and % Recovery	Samples and/or Cores	Depth in Feet	Graph Symbol	Letter Symbol	Description
								Asphaltic pavement with gravel subbase
							MH	Brown clayey silt with boulders (medium stiff)
		53/7"						becomes gray in color and stiff
		50/5"						Water level at 1500 hours on 8-21-74
					10			colors red- brown
		45/3"					MH	Mottled gray and brown clayey silt (stiff) (decomposed basalt)
		50/4"						Gray vesicular basalt (hard)
			NX 100%		20			
								Boring completed at 22.0 feet on 8-21-74

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- □ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN

Driving Energy - 300-lb weight dropping 30 inches

DAMES & MOORE
PLATE A-1H

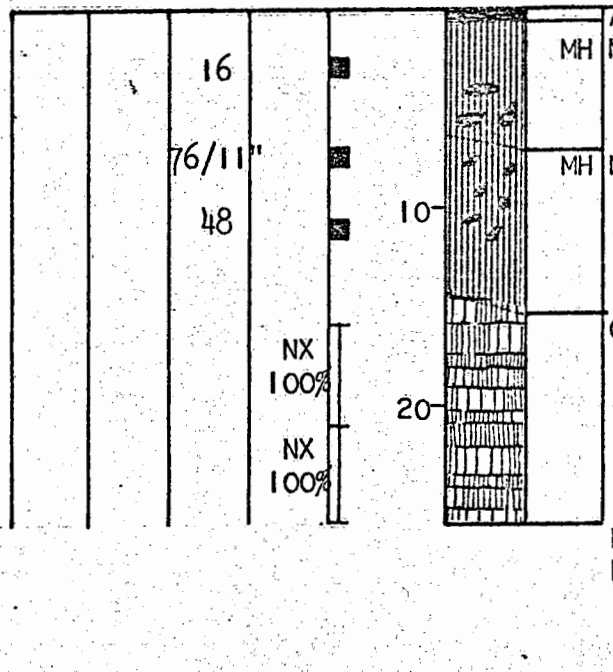
REVISIONS BY DATE

FILE 9202-024

CHECKED BY AEV DATE 9-11-74

BORING 9

Surface Elevation 62 ± feet
MSL Datum



Description

Asphaltic pavement with gravel subbase

MH Mottled gray and brown clayey silt (stiff)

grades with boulders

MH Mottled gray and brown clayey silt with basalt cobbles (stiff) (decomposed basalt)

Gray basalt vesiculat (hard)

Boring completed at 26.0 feet on 8-22-74
No water measured
(Hole caved in before water level stabilized)

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- □ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN

Driving Energy - 300-LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE
PLATE A-11

VIS BY DATE
FILE 9107-051
CHECKED BY REV 9-11-74

BORING 10

SURFACE ELEVATION 57 ± FEET
MSL DATUM

MOISTURE CONTENT IN %	DRY DENSITY IN PCF	BLOWS/FT. ON SAMPLER	CORE AND % RECOVERY	SAMPLES AND/OR CORES	DEPTH IN FEET	GRAPH SYMBOL	LETTER SYMBOL	DESCRIPTION
							MH	ASPHALTIC PAVEMENT WITH GRAVEL SUBBASE BROWN CLAYEY SILT (FILL)
							O.H	BLACK ORGANIC CLAYEY SILT WITH BROKEN GLASS (MEDIUM STIFF) (FILL)
		12					MH	GRAY MOTTLED BROWN CLAYEY SILT WITH SOME BOULDERS (STIFF)(DECOMPOSED BASALT)
54.1	89.0	72/10"			10			
		62/11"	NX 84%					GRAY BASALT, SLIGHTLY VESICULAR (HARD)

BORING COMPLETED AT 16.5 FEET ON 8-22-74
NO WATER MEASURED
(HOLE CAVED IN BEFORE WATER LEVEL STABILIZED)

VIS BY ____ DATE ____
FILE 9207-001
CHECKED BY ____ DATE 8-11-74

LOG OF BORINGS

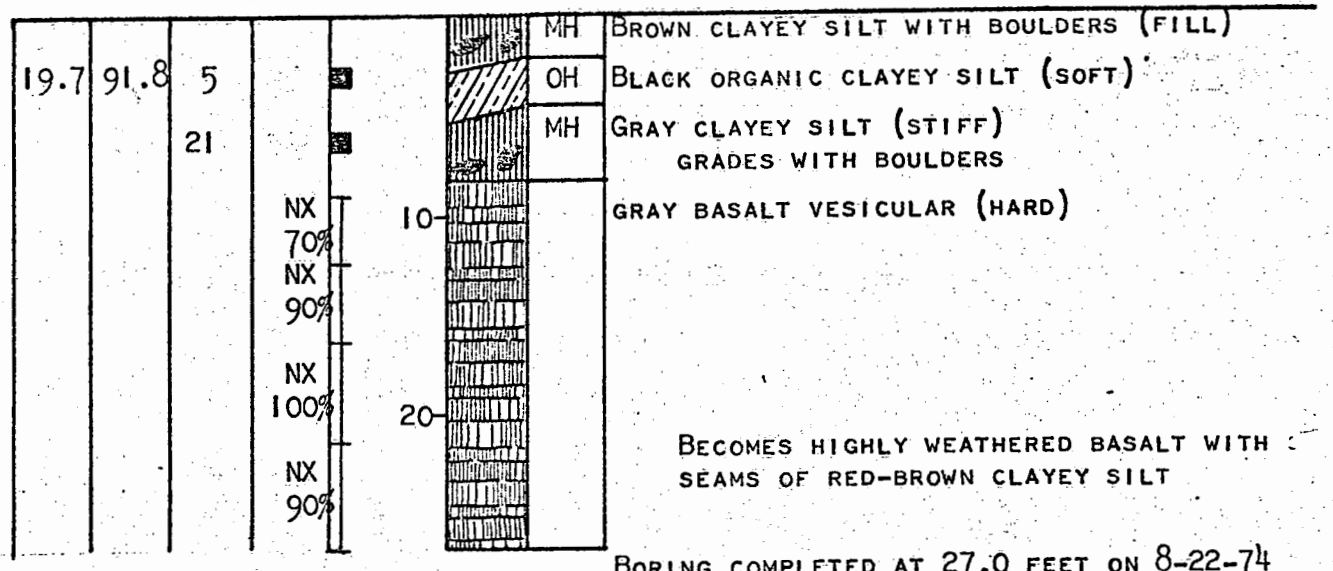
NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- ☐ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN
- DRIVING ENERGY - 300-LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE
PLATE A-1J

BORING 11

Surface Elevation 54 ± feet
MSL Datum



Boring completed at 27.0 feet on 8-22-74
No water table measured
(Hole caved in before water level stabilized)

LOG OF BORINGS

NOTES:

- ▣ -DEPTH AT WHICH UNDISTURBED SAMPLE WAS TAKEN
- ⊠ -DEPTH AT WHICH DISTURBED SAMPLE WAS TAKEN
- □ -DEPTH AT WHICH SAMPLE WAS LOST DURING EXTRACTION
- I -DEPTH AND LENGTH OF CORE RUN

Driving Energy - 300-LB WEIGHT DROPPING 30 INCHES

DAMES & MOORE
PLATE A-1K

VISI BY ____ DATE ____
FILE 2311-Proj
CHECKED BY 2311 9-11-74

TEST PIT 1

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler Samples and/or Cores	Depth in Feet	Graph Symbol	Letter Symbol	Description
					MH	Brown clayey silt with some boulders and roots 6" to 2.5' in diameter, (medium stiff)(fill)
			10		MH	Gray mottled brown clayey silt with some sand and boulders (stiff)(decomposed basalt)
						▽ Water level at 1400 hours on 8-26-74
						Gray basalt (hard)
						Test pit completed at 10.5 feet on 8-26-74

TEST PIT 2

Moisture Content in %	Dry Density in PCF	Blows/Ft. onSampler Samples and/or Cores	Depth in Feet	Graph Symbol	Letter Symbol	Description
					MH	Brown clayey silt with some gravel
						Concrete slab
			5		MH	Brown clayey silt with some boulders and roots (stiff)
					OH	Gray organic silt
						Gray basalt (hard)
						Test pit completed at 5.5 feet on 8-26-74
						No water encountered

TEST PIT 3

Moisture Content in %	Dry Densi ty in PCF	Blows/Ft. on Sampler Samples and/or Cores	Depth in Feet	Graph Symbol	Letter Symbol	Description
					MH	Brown clayey silt with cobbles and roots (medium stiff) (fill)
			5		MH-ML	Gray brown clayey silt with some sand (decomposed basalt)
						Test pit completed at 8.0 feet on 8-26-74
						No water encountered

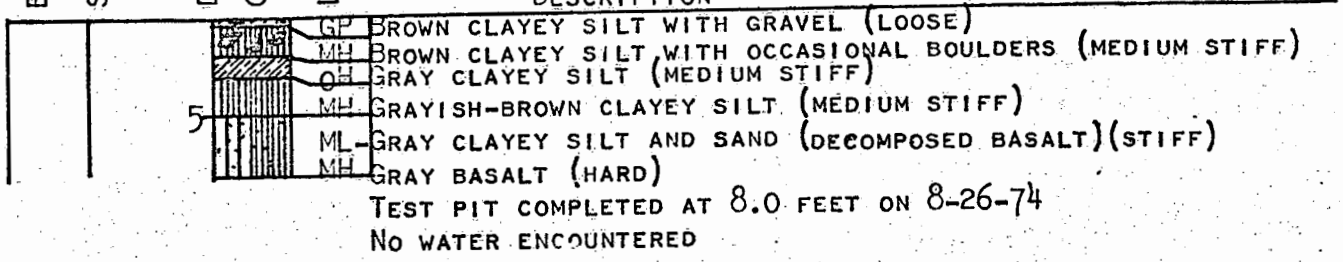
TEST PIT 4

Moisture Content in %	Dry Density in PCF	Blows/Ft. on Sampler Samples and/or Cores	Depth in Feet	Graph Symbol	Letter Symbol	Description
					GP	Brown clayey silt and gravel (loose)(road sub-base)
					CL	Brown clayey silt with basalt boulders (medium stiff)(fill)
					OH	Gray organic silt
			5		MH	Grades with boulders up to 2 feet in diameter
						Gray clayey silt with sand and some boulders(decomposed basalt)
						Gray basalt (hard)
						Test pit completed at 8.5 feet on 8-26-74
						No water encountered

DAMES & MOORE

PLATE A-1L

TEST PIT 5



Surface Elevation 55.0 ± feet
MSL Datum

Test pit completed at 8.0 feet on 8-26-74
No water encountered

REVISIONS BY DATE

FILE 9507-102

CHECKED BY AKV DATE 9-13-74

DAMES & MOORE

PLATE A-1M

SOIL CLASSIFICATION CHART

MAJOR DIVISIONS			GRAPH SYMBOL	LETTER SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS — MORE THAN 50 % OF MATERIAL IS LARGER THAN NO. 200 SIEVE SIZE	GRAVEL AND GRAVELLY SOILS — MORE THAN 50 % OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVELS (LITTLE OR NO FINES)		GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
				GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES, LITTLE OR NO FINES
		GRAVELS WITH FINES (APPRECIABLE AMOUNT OF FINES)		GM	SILTY GRAVELS, GRAVEL-SAND-SILT MIXTURES
				GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SAND AND SANDY SOILS — MORE THAN 50% OF COARSE FRACTION PASSING NO. 4 SIEVE	CLEAN SAND (LITTLE OR NO FINES)		SW	WELL-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
				SP	POORLY-GRADED SANDS, GRAVELLY SANDS, LITTLE OR NO FINES
		SANDS WITH FINES (APPRECIABLE AMOUNT OF FINES)		SM	SILTY SANDS, SAND-SILT MIXTURES
				SC	CLAYEY SANDS, SAND-CLAY MIXTURES
FINE GRAINED SOILS — MORE THAN 50 % OF MATERIAL IS SMALLER THAN NO 200 SIEVE SIZE	SILTS AND CLAYS — LIQUID LIMIT LESS THAN 50			ML	INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
				OL	ORGANIC SILTS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS — LIQUID LIMIT GREATER THAN 50			MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILTY SOILS
				CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
				OH	ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICTY, ORGANIC SILTS
HIGHLY ORGANIC SOILS				PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

FOR LABORATORY CLASSIFICATION OF FINE-GRAINED SOILS

NOTES:

1. DUAL SYMBOLS ARE USED TO INDICATE BORDERLINE CLASSIFICATIONS.
2. WHEN SHOWN ON THE BORING LOGS, THE FOLLOWING TERMS ARE USED TO DESCRIBE THE CONSISTENCY OF COHESIVE SOILS AND THE RELATIVE COMPACTNESS OF COHESIONLESS SOILS.

COHESIVE SOILS	(APPROXIMATE SHEARING STRENGTH IN KSF)
VERY SOFT	LESS THAN .25
SOFT	0.25 TO 0.5
MEDIUM STIFF	0.5 TO 1.0
STIFF	1.0 TO 2.0
VERY STIFF	2.0 TO 4.0
HARD	GREATER THAN 4.0

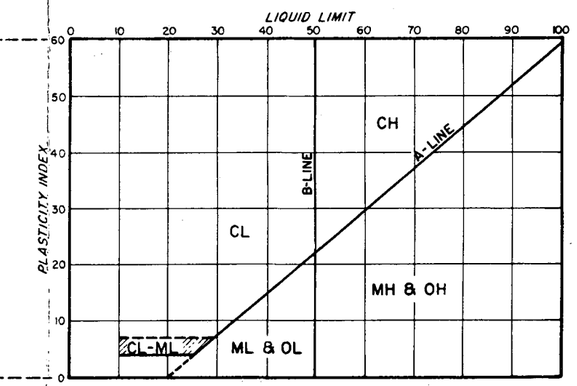
COHESIONLESS SOILS	
VERY LOOSE	THESE ARE USUALLY BASED ON AN EXAMINATION OF SOIL SAMPLES, PENETRATION RESISTANCE, AND SOIL DENSITY DATA.
LOOSE	
MEDIUM DENSE	
DENSE	
VERY DENSE	

GRADATION CHART

MATERIAL SIZE	PARTICLE SIZE			
	LOWER LIMIT		UPPER LIMIT	
	MILLIMETERS	SIEVE SIZE*	MILLIMETERS	SIEVE SIZE*
SAND				
FINE	.074	#200*	0.42	#40*
MEDIUM	0.42	#40*	2.00	#10*
COARSE	2.00	#10*	4.76	#4*
GRAVEL				
FINE	4.76	#4*	19.1	3/4"*
COARSE	19.1	3/4"*	76.2	3"*
COBBLES	76.2	3"*	304.8	12"*
BOULDERS	304.8	12"*	914.4	36"

#U.S. STANDARD *CLEAR SQUARE OPENINGS

PLASTICITY CHART



SAMPLES

- ■ INDICATES UNDISTURBED SAMPLE
- ⊠ INDICATES DISTURBED SAMPLE
- □ INDICATES SAMPLING ATTEMPT WITH NO RECOVERY
- I INDICATES LENGTH OF CORING RUN

NOTE:
DEFINITIONS OF ANY ADDITIONAL DATA REGARDING SAMPLES ARE ENTERED ON THE FIRST LOG ON WHICH THE DATA APPEAR.

UNIFIED SOIL CLASSIFICATION SYSTEM

DAMES & MOORE

PLATE A-2

CHECKED BY ... 9-11-7? FILE 9807-001

2 (REV. 3-65)

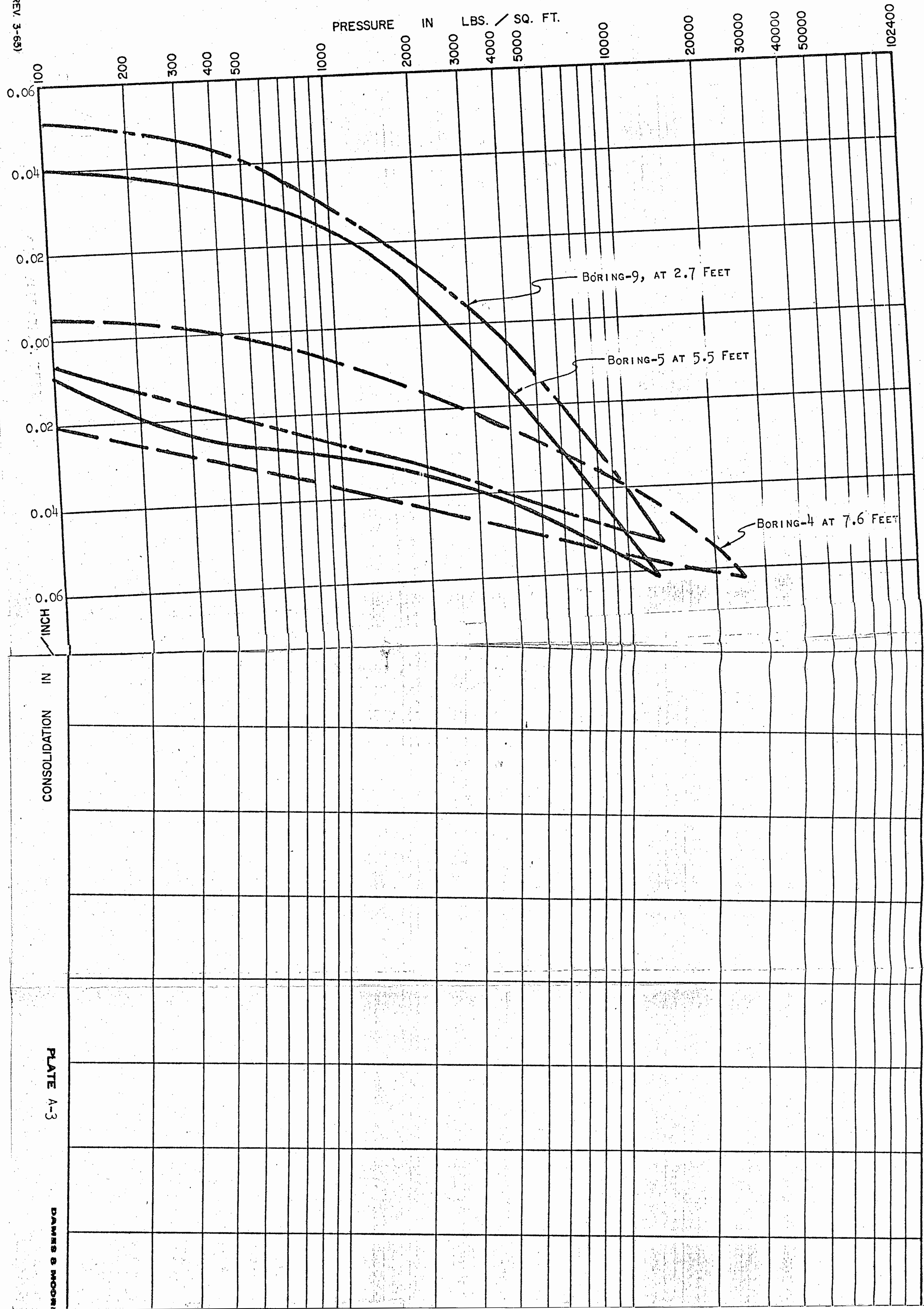


PLATE A-3

DAMES & MOORE

CHECKED BY DHV DATE 9-11-74

FILE 9807-001

PRESSURE IN LBS. / SQ. FT.

100 200 300 400 500 1000 2000 3000 4000 5000 10000 20000 30000 40000 50000 [illegible]

CONSOLIDATION IN INCHES / INCH

0.06 0.04 0.02 0.00 0.02 0.04 0.06 0.08

BORING-9, AT 2.7 FEET

BORING-5 AT 5.5 FEET

BORING-4 AT 7.6 FEET

PLATE A-3

DAMES & MOORE